

## DESCRIPTION

STEERING APPARATUS

## 5 Technical Field

The present invention relates to a tilt/telescopic type steering apparatus capable of adjusting a tilt angle of a steering wheel and an axis-directional position thereof, corresponding to a driving posture (position) of a driver.

## Background Arts

What is known as a steering apparatus for an automotive vehicle is a tilt/telescopic type steering apparatus capable of adjusting a tilt angle of a steering wheel and an axis-directional position of the steering wheel, corresponding to a physique and a driving posture of a driver.

In this respect, there is an idea that components of the tilt/telescopic type steering apparatus are disposed as close to a steering shaft as possible in order to ensure a space in the vicinity of knees of the driver. Based on this idea, Japanese Patent Application Laid-Open No.2001-191927 discloses a steering apparatus constructed such that support members disposed within a steering column are interposed between a pair of brackets and are displaced

along tilt grooves formed in the brackets or along  
telescopic grooves formed in the steering column, and  
this causes the two brackets to get displaced in the  
same direction, thereby adjusting a tilt angle and an  
5 axis-directional displacement of the steering shaft  
supported rotatably with respect to the steering column.

By the way, according to the prior art described  
above, the steering column is fixed by pushing one  
bracket against the steering column via an intermediate  
10 member, however, at this time, the other bracket is  
pushed via the support member, and this might cause an  
axis deviation of the steering shaft. A rigidity of  
the other bracket must be increased for preventing the  
axis deviation, however, this might induce rises both  
15 in weight and in costs. On the other hand, a  
presumable construction is that the two brackets are  
pressed from both sides against the steering column,  
however, this construction involves such a laborious  
operation that the driver must rotate two pieces of  
20 levers by hands, and there arises a problem in which  
the operability declines.

#### Disclosure of the Invention

It is an object of the present invention, which  
25 was devised in view of the problems inherent in the  
prior art described above, to provide a steering  
apparatus capable of preventing an axis deviation of a

steering shaft and exhibiting excellency of its operability.

To accomplish the above object, according to the present invention, in a steering apparatus for

5 supporting a steering shaft to which a steering wheel is attached so that the steering shaft is displaceable in an axis-direction, there is provided an improvement characterized by comprising an inner column for supporting the steering shaft rotatably, a pair of

10 brackets fitted to a car body and disposed in positions facing each other with respect to an axis of the steering shaft, a tension member extending between the pair of brackets, two pieces of fixing members for fixing the tension member from outside of the pair of

15 brackets, a displacement causing member, disposed between the bracket and the fixing member, for causing a relative displacement between the bracket and the fixing member, and an outer column held on the car body through a connection between the tension member, the

20 brackets and the fixing members, having a pressing portion of which an outer periphery is brought into contact with both of the pair of brackets due to the relative displacement of the brackets between at least the pair of brackets, and having an inner peripheral

25 surface embracing an outer periphery of the inner column, wherein the pair of brackets interlocking with the tension member gets close to each other due to the

displacement caused by the displacement causing member,  
a pressing force is thereby applied to the inner column  
via the pressing portion of the outer column, and the  
inner column maintains its axis-directional position  
5 with respect to the brackets through the outer column.

According to the steering apparatus of the  
present invention, the pair of brackets gets close to  
each other by dint of the displacement caused by the  
displacement causing member, with the result that a  
10 distance between the brackets decreases. The outer  
column is thereby held between the tension member and  
the brackets. Further, the displaced brackets apply a  
pressing force to the inner column via the pressing  
portion of the outer column, whereby the inner column  
15 is held by the brackets connected to the car body  
through the outer column. The steering shaft can be  
therefore fixed in the telescoping direction. Moreover,  
the pair of brackets is connected to the tension member,  
and hence, if the two brackets take approximately a  
20 symmetrical configuration with respect to the steering  
shaft interposed therebetween, displaced quantities of  
the respective brackets are equalized. A central  
position of the inner column can be thereby kept  
substantially fixed, so that the axis deviation of the  
25 steering shaft can be effectively restrained. Note  
that a preferable arrangement is that when a line  
connecting centers of the two fixing members intersects

an axis of the inner column (or the steering shaft),  
the pressing force can be applied uniformly to the  
inner column. Further, it is preferable that when the  
outer column formed with slits disposed upwards and  
5 downwards with the steering shaft interposed  
therebetween, the outer column can be made to deform by  
a smaller force in order to hold the inner column.

Still further, it is preferable that an axis of  
the steering shaft substantially intersects a line that  
10 connects centers of the two fixing members.

Yet further, the pair of brackets is formed with  
tilt grooves, whereby, for example, the inner column  
can be tilted together with the outer column.

Moreover, when the outer column includes an  
15 integrally-formed car body fitting portion, the inner  
column can be held on the car body through the outer  
column.

Furthermore, when part of the inner column is  
formed with at least one elongate hole extending in an  
20 axis-direction, and when an inner peripheral surface of  
the outer column is formed with a protruded portion  
engaging with the elongate hole and extending inwards  
in a radial direction, the inner column can be  
telescoped (displaced in the axis-direction).

25 Further, one of the inner column and the outer  
column is provided with a protruded portion extending  
in a radial direction, and, when the inner column and

the outer column make their displacements in the axis-  
directions, the protruded portion abuts on the other of  
the inner column and the outer column and is thus made  
to function as a telescopic stopper for blocking a  
5 further displacement. With this contrivance, the inner  
column can be restrained from coming off the outer  
column.

Moreover, when the tension member is constructed  
of a plurality of parts that can be divided so as to  
10 form an annular configuration embracing the outer  
column, the assembly is facilitated.

#### Brief Description of the Drawings

FIG. 1 is a cross-sectional view of a  
15 tilt/telescopic type steering apparatus according to a  
first embodiment of the present invention;

FIG. 2 is a side view of the steering apparatus  
shown in FIG. 1;

FIG. 3 is a top view of the steering apparatus  
20 shown in FIG. 1;

FIG. 4 is a view of the steering apparatus shown  
in FIG. 2 as viewed in an arrowhead-direction III;

FIG. 5 is a cross-sectional view of the  
tilt/telescopic type steering apparatus according to a  
25 second embodiment of the present invention;

FIG. 6 is a side view of the steering apparatus  
shown in FIG. 5;

FIG. 7 is a top view of the steering apparatus shown in FIG. 5;

FIG. 8 is a partially sectional side view of a tilt type steering apparatus according to a third  
5 embodiment of the present invention;

FIG. 9 is a top view of the steering apparatus shown in FIG. 8;

FIG. 10 is a partially sectional side view of the tilt type steering apparatus according to a fourth  
10 embodiment of the present invention;

FIG. 11 is an enlarged view of a portion indicated by an arrowhead XI in a construction shown in FIG. 10;

FIG. 12 is a partially sectional side view of the  
15 tilt type steering apparatus according to a fifth embodiment of the present invention;

FIG. 13 is a top view of the steering apparatus shown in FIG. 12;

FIG. 14 is a sectional view, similar to FIG. 1,  
20 of the tilt type steering apparatus according to a sixth embodiment of the present invention;

FIG. 15 is a sectional view, similar to FIG. 14, of the tilt type steering apparatus according to a seventh embodiment of the present invention; and

25 FIG. 16 is a sectional view, similar to FIG. 15, of the tilt type steering apparatus according to an eighth embodiment of the present invention.

### Best Mode for Carrying out the Invention

A tilt/telescopic type steering apparatus according to embodiments of the present invention will hereinafter be described with reference to the drawings. FIG. 1 is a cross-sectional view of the tilt/telescopic type steering apparatus according to a first embodiment of the present invention. FIG. 2 is a side view of the steering apparatus shown in FIG. 1. FIG. 3 is a top view of the steering apparatus shown in FIG. 1. FIG. 4 is a view of the steering apparatus shown in FIG. 2 as viewed in an arrowhead-direction III.

Referring to FIG. 1, two pieces of brackets 12 each composed of a plate material bent in an L-shape, are attached through a pair of release capsules 15 to a top plate 1 secured to an unillustrated car body. A plate thickness of each of the brackets 12 is the same, and the brackets 12 take a configuration exhibiting a line symmetry with respect to a perpendicular line. The release capsule 15, upon a secondary collision, functions such that the release capsule 15 gets collapsed when an impact load acts on a steering column towards the front of the vehicle, and gets released together with the car body sided bracket 12 from the car body, thereby enabling the steering column to get displaced towards the front of the vehicle.

A tension member 13 is disposed between the



brackets 12, 12. The tension member 13 is a member taking substantially an annular shape in its assembled state. The tension member 13 can be divided at its center into two parts, i.e., a left-half tension member 5 13a and a right-half tension member 13b. To be more specific, two pieces of bolts 14, 14 inserted through a screw hole 13c formed in the left-half tension member 13a and a screw hole 13d formed in the right-half tension member 13b, are fastened, thereby assembling 10 the left-half tension member 13a and the right-half tension member 13b together. The tension member 13 can be thus acquired. Based on this construction, the left- and right-half tension members 13a, 13b remain separated before being mounted in the real car and made 15 integral with each other when mounted in the real car by use of a bolt 14, thereby enabling the assembly to be more facilitated.

A cylindrical inner column 11 is disposed inwardly of the tension member 13. A steering shaft S 20 is inserted through within the inner column 11 and is rotatably supported via an unillustrated bearing within the inner column 11.

Telescopic grooves 11a are, as illustrated in FIG. 2, formed as elongate holes in parallel with the axis 25 of the steering shaft S on both sides of the inner column 11. On the other hand, the bracket 12 is formed with a tilt groove 12a serving as part of a circular

arc depicted when the steering shaft S is tilted about a pivotal motion point P, and, in the assembled state, the telescopic groove 11a and the tilt groove 12a are partly overlapped with each other as viewed in the direction shown in FIG. 2. A fixing member 16 is so inserted from the left side in FIG. 1 as to penetrate the tilt groove 12a, while a fixing member 17 is inserted from the right side in FIG. 1. Axes of the fixing members 16, 17 substantially intersect (actually intersect or extend in the vicinity of) the axis of the steering shaft S.

The fixing member 16 includes a disc-like head portion 16a larger than a width of the tilt groove 12 on the left side in FIG. 1, an angular-pole-like tilt guided portion 16b engaging with and thus guided along within the tilt groove 12a, a male screw portion 16c screwed into a screw through-hole 13e formed in the left-half tension member 13c of the tension member 13, and an angular-pole-like telescopic guided portion 16d engaging with and thus guided along within the telescopic groove on the left side in FIG. 1.

On the other hand, the fixing member 17 includes a head portion 17a, an elongate tilt guided portion 17b taking a cylindrical shape and having a diametrical dimension slightly smaller than a width of the tilt groove 12a, a male screw portion 17c screwed into a screw through-hole 13f formed in the right-half tension

member 13b of the tension member 13, and an angular-  
pole-like telescopic guided portion 17d engaging with  
and thus guided along within the telescopic groove 11a  
on the right side in FIG. 1. Note that telescopic  
5 guided portions 16d, 17d configure protruded portions  
engaging with the telescopic grooves 11a and extending  
inwards in the diametrical directions.

Provided along a periphery of the guided portion  
17b of the fixing member 17 are a first cam member 18.  
10 that partly engages with the telescopic groove 11a and  
is therefore incapable of rotating, a second cam member  
19 disposed adjacent to the first cam member 18,  
attached to a side end portion of a lever L and  
rotatable together with the lever L, and a bearing 20  
15 interposed in between and held by the head portion 17a  
and the side end portion of the lever L. It should be  
noted that the first cam member 18, the second cam  
member 19 and the lever L constitute a displacing  
member.

20 An outer column 21 has a cylindrical portion 21a,  
a pair of arm portions 21b (which are car body fitting  
portions of which only one is shown in FIG. 3)  
extending from the cylindrical portion 21 towards the  
left in FIG. 2, and a pair of flange portions 21c, 21d  
25 disposed at some interval in the axis-direction shown  
in FIG. 3 along an outer periphery of the right side  
end portion of the cylindrical portion 21a in FIG. 2.

The cylindrical portion 21a embraces the inner column 11, and a side end portion of the arm portion 21b so supported by a support member 22 on the unillustrated car body as to be capable of swinging about a pivotal support point O. The tension member 13 is disposed between the flange portions 21c, 21d serving as a pressing portion. Note that the cylindrical portion 21a is formed with a pair of slits 21e (appearing more exaggerated than in reality) in positions apart through 90 degrees from the fixing members 16, 17 so as to split the flange portions 21c, 21d from the right side ends thereof as shown in FIGS. 3 and 4.

As illustrated in FIG. 2, a coil spring W is disposed between the bracket 12 and the outer column 21. The coil spring W biases the outer column 21 upwards in FIG. 2 towards the bracket 12, thereby canceling a self-weight of the unillustrated steering wheel, etc. attached to the right side end of the steering shaft S.

Next, an adjusting operation of the steering apparatus in the first embodiment will be explained. When an operator (driver) rotates the lever L in a fastening direction up to a position depicted by a solid line in FIG. 2, the protruded portions of the first cam member 18 and the second cam member 19 in the fixing member 17 engage with each other in FIG. 1, thereby generating a force acting in such directions as to separate from each other. At this time, the bracket

12 on the right side in FIG. 1, which is pressed by the first cam member 18, gets displaced to the left. While on the other hand, the fixing member 17 pressed rightwards by the second cam member 19 displaces the tension member 13 towards the right. The tension member 13, with this displacement thereof, pushes the side portions of the flange portions 21c, 21d of the outer column 21 against both sides of the tilt grooves 12a of the brackets 12, thus giving proper pressing forces. The outer column 21 is thereby fixed to the brackets 12, with the result that tilt-directional displacement of the inner column 11 is blocked.

On the other hand, when the bracket 12 on the right side in FIG. 1, which has been pressed by the first cam member 18, gets displaced to the left as the lever L is rotated in the fastening direction, this bracket 12 abuts on right-half portions of the flange portions 21c, 21d and similarly displaces these portions to the left, thereby applying a pressing force to an outer peripheral surface of the inner column 11. Further, the force given by the tension member 13 is transferred to the fixing member 16 disposed on the opposite side, whereby the bracket 12 on the left side in FIG. 1, which has been pressed by this force, gets displaced to the right. The left-side bracket 12, when getting displaced to the right, abuts on the left-half portions of the flange portions 21c, 21d and similarly

displaces these portions to the right, thereby applying the pressing force to the outer peripheral surface of the inner column 11.

According to the first embodiment, the two  
5 brackets 12 have substantially the same configuration and the plate thickness, i.e., have substantially the same flexural elastic coefficient (namely, the same rigidity). Hence, the brackets 12 receive the forces in such directions as to have proximity to each other  
10 and make substantially the same amount of displacement. Then, the inner column 11 receives the pressing forces from both of the right and left sides in FIG. 1 via the flange portions 21c, 21d, and is fixed so that the center of the inner column 11 is coincident with such a  
15 position as to halve a distance between the brackets 12, 12. With this arrangement, an axis deviation of the steering shaft S can be restrained while being capable of blocking the displacement in a telescoping direction. Note that the first embodiment takes the construction,  
20 wherein as the slits 21e are formed upwardly and downwardly of the outer column 21, the rigidity of the outer column 21 decreases, and the flange portions 21c, 21d are easy to get displaced in the direction towards the inner column 11.

25 A requirement for attaining the operations described above is that an increment quantity  $\Delta D$  of a distance D from the head portion 17a of the fixing

member 17 to the side end surface of the bracket 12 when fastening the lever L should be, as shown in FIG. 1, larger than a value obtained by subtracting a width B of the tension member 13 from an interval C between  
5 the brackets 12, 12 in a free state (wherein, the above value is a sum of a gap F between the right-side bracket 12 in FIG. 1 and the tension member 13 and of a gap F' between the left-side bracket 12 and the tension member 12). Namely, the requirement is given by  $\Delta D >$   
10  $(F + F')$ . The increment quantity  $\Delta D$  can be adjusted by changing heights of the ride-on protruded portions (unillustrated) of the first cam member 18 and the second cam member 19.

By contrast, when the operator (driver) rotates  
15 the lever L in a slackening direction down to a position depicted by a two-dotted chain line in FIG. 2, the protruded portions of the first cam member 18 and the second cam member 19 disengage from each other in FIG. 1, resulting in a return to the initial distance D  
20 from the head portion 17a of the fixing member 17 to the side end surface of the bracket 12. This causes the bracket 12 to separate away from the tension member 13 with the result that the outer column 21 comes to a free state with respect to the bracket 12. Therefore,  
25 the tilt guided portions 16b, 17b of the fixing members 16, 17 are displaced while being guided along the tilt grooves 12a, 12a of the brackets 12, 12, or

alternatively the telescopic guided portions 16d, 17d are displaced while being guided along the telescopic grooves 11a of the inner column 11, whereby the adjustment in the tilting direction and in the  
5 telescoping direction can be arbitrarily made.

It is required for attaining the operations described above that the interval C between the brackets 12 in the free state be larger than the width B of the tension member 12. Namely, the requirement is  
10 given such as  $C > B$ . It is to be noted that a value of  $(C - B)$  is changed by varying a screw-in quantity of the fixing member into the tension member 13, and it is therefore possible to adjust the pressing force between the bracket 12 and the tension member 13 when fastening  
15 the lever L.

FIG. 5 is a cross-sectional view of the tilt/telescopic type steering apparatus according to a second embodiment of the present invention. FIG. 6 is a side view of the steering apparatus shown in FIG. 5.  
20 FIG. 7 is a top view of the steering apparatus shown in FIG. 5. It is only a different point of the second embodiment from the first embodiment shown in FIGS. 1 through 4 to provide an additional construction, and hence common components other than this difference are  
25 marked with the same numerals and symbols, of which the repetitive explanations are herein omitted.

To give a more specific description about the



different point, a plurality (which is herein represented by four pieces) of friction plates 30 receiving penetration of one of the fixing members 16, 17 and extending in vertical directions in FIG. 5 are, as shown in FIGS. 6 and 7, disposed between the flange portions of the outer column 21 and the two brackets 12. As illustrated in FIG. 5, the four friction plates 30 are attached to the brackets 12 by use of two pieces of caulking pins 31 but are displaceable in an axis-direction of the caulking pin 31.

Further, referring to FIG. 7, similarly a plurality (which is herein represented by four pieces) of friction plates 33 receiving penetration of one of the fixing members 16, 17 and extending in horizontal directions in FIG. 7 are disposed crosswise over the individual friction plates 30 between the flange portions of the outer column 21 and the two brackets 12. Each set of four friction plates 33 is attached to each of both sides of the inner column 11 through a piece of pin 34 but is displaceable in an axis-direction of the pin 34.

To describe an adjusting operation of the steering apparatus in the second embodiment, referring to FIG. 5, when the operator (driver) rotates the lever L in the fastening direction, the protruded portions of the first cam member 18 and the second cam member 19 engage with each other, thereby generating forces in

such directions as to separate from each other. At this time, the bracket 12 on the right side in FIG. 1, which is pressed by the first cam member 18, gets displaced to the left. While on the other hand, the  
5 fixing member 17 pressed rightwards by the second cam member 19 displaces the tension member 13 towards the right. The tension member 13, with this displacement thereof, pushes the flange portions 21c, 21d of the outer column 21 against peripheries of the tilt grooves  
10 12a of the brackets 12 through the friction plates 30, 33, thus giving proper pressing forces. The outer column 21 is thereby fixed to the brackets 12 with the aide of the tremendous frictional forces of the friction plates 30 and 33, with the result that tilt-  
15 directional displacement of the inner column 11 is blocked.

On the other hand, when the bracket 12 on the right side in FIG. 1, which has been pressed by the first cam member 18, gets displaced to the left as the  
20 lever L is rotated in the fastening direction, this bracket 12 abuts on right-half portions of the flange portions 21c, 21d via the friction plates 30, 33 and similarly displaces these portions to the left, thereby applying a pressing force to an outer peripheral  
25 surface of the inner column 11. Further, the force given by the tension member 13 is transferred to the fixing member 16 disposed on the opposite side, whereby

the bracket 12 on the left side in FIG. 1, which has been pressed by this force, gets displaced to the right. The left-side bracket 12, when getting displaced to the right, abuts on the left-half portions of the flange portions 21c, 21d via the friction plates 30, 33 and similarly displaces these portions to the right, thereby applying the pressing force to the outer peripheral surface of the inner column 11. Consequently, the tremendous frictional forces occur on the friction plates 30, 33. Namely, according to the second embodiment, the force of holding the outer column 21 can be augmented by using the friction plates 30, 33 more than in the first embodiment discussed above.

FIG. 8 is a partially sectional side view of the tilt/telescopic type steering apparatus according to a third embodiment of the present invention. FIG. 9 is a top view of the steering apparatus shown in FIG. 8. It is only a different point of the third embodiment from the first embodiment illustrated in FIGS. 1 through 4 to omit the telescopic (axis-directional) adjusting function, and hence common components other than this difference are marked with the same numerals and symbols, of which the repetitive explanations are herein omitted.

To give a more specific description about the different point, an outer column 21' is, as shown in

FIG. 8, formed with a screw hole 21f' in its upper portion. A pin-attached bolt 40 is screwed into this screw hole 21f' from an outer peripheral side thereof. The pin-attached bolt 40 is formed with a pin portion  
5 40a at its front side end. The pin portion 40a protrudes inwards in a radial direction from an inner peripheral surface of the outer column 21', and engages with an elongate hole 11c' formed in an upper portion of the inner column 11'. Note that the inner column  
10 11' has telescopic holes formed along the peripheries of the fixing members 16, 17 in the third embodiment.

According to the third embodiment, the outer column 21' is provided with the pin-attached bolt 40 as the protruded portion extending in the radial direction,  
15 and the pin portion 40a engages with the elongate hole 11c'. With this arrangement, when the inner column 11' and the outer column 21' get displaced in their axis-directions, the pin-attached bolt 40 abuts on (engages with) the side end portion of the elongate hole 11c' of  
20 the inner column 11' and thus functions as a telescoping stopper for blocking further displacements thereof. Note that the inner column 11' may be formed with a telescoping stopper as a protruded portion, and relative displacements may be blocked by abutting on  
25 (engaging with) the outer column 21'.

FIG. 10 is a partially sectional side view of the tilt/telescopic type steering apparatus according to a

fourth embodiment of the present invention. FIG. 11 is an enlarged view of a portion indicated by an arrowhead XI in a construction shown in FIG. 10. In the fourth embodiment also, the components common to those in the first through third embodiments illustrated in FIGS. 1 through 9 are marked with the same numerals and symbols, of which the repetitive explanations are herein omitted.

Referring to FIG. 11, a diameter-reduced portion 21h" of which a diameter is slightly reduced is formed in an inner peripheral surface in the vicinity of a right side end, as viewed in FIG. 11, of an outer column 21". Further, a diameter-expanded portion 21g" of which a diameter is slightly expanded is formed in the inner peripheral surface in the vicinity of a left side end as viewed in FIG. 11. A cylindrical retainer 41 is fitted into and thus disposed in the diameter-expanded portion 21g". A length of the retainer 41 in the axis-direction is substantially the same as a length of the diameter-expanded portion 21g" in the axis-direction. An inside diameter of an inner peripheral surface of the retainer 41 is substantially equal to an inside diameter of an inner peripheral surface of the diameter-reduced portion 21h" but is smaller than an inside diameter of an inner peripheral surface throughout the outer column 21" excluding the diameter-reduced portion 21h".

Accordingly, in a state where an outer peripheral

surface of the inner column 11' abuts on the inner peripheral surface of the retainer 41 (which is made of, preferably, a material exhibiting excellency in terms of slidability), a gap  $\Delta$  is produced throughout between  
5 the outer peripheral surface of the inner column 11' and the inner peripheral surface of the outer column 21" other than the diameter-reduced portion 21h". Thus, the outer peripheral surface of the inner column 11' is retained only by the retainer 41 and the diameter-  
10 reduced portion 21h". It is therefore possible to largely decrease a slide resistance when the inner column 11' moves relatively to the outer column 21".

Moreover, considering a case in which the outer column 21" and the inner column 11' relatively slide on  
15 each other, there is needed an accurate design work about an inside diameter of the outer column 21" and an outside diameter of the inner column 11', which slide on each other. According to a construction that the entire inner and outer peripheral surfaces of the two  
20 columns 21" and 11' slide on each other, however, it is difficult to conduct highly accurate dimensional control over the whole thereof. As a result, the slide resistance might increase, and a backlash might occur. By contrast, as in the fourth embodiment, when the  
25 outer peripheral surface of the inner column 11' is retained only by the retained 41 and the diameter-reduced portion 21h", the highly accurate design work

about only the sliding portions thereof may suffice,  
and the dimensional management can be facilitated.

FIG. 12 is a partially sectional side view of the  
tilt/telescopic type steering apparatus according to a  
5 fifth embodiment of the present invention. FIG. 13 is  
a top view of the steering apparatus shown in FIG. 12.  
The fifth embodiment has a difference from the second  
embodiment illustrated in FIGS. 5 through 7 only about  
a point of employing circular washers 33' as a  
10 substitute for the elongate friction plates 33. The  
common components other than the circular washers are  
marked with the same numerals and symbols, of which the  
repetitive explanations are herein omitted. It should  
be noted that as the friction plates 33 are replaced by  
15 the washers 33', the pins 34 are also omitted.

According to the fifth embodiment, in the tilting  
direction, even if a large load as by the secondary  
collision is applied due to a large frictional force  
acting on between the four pieces of friction plates 30  
20 and the washers 33' disposed crosswise over these  
plates, the outer column 21 can be surely held. While  
in the telescoping direction, none of the friction  
plates being provided, such a large load is received  
mainly by the slide resistance between the outer column  
25 21 and the inner column 11, and hence a start-of-  
movement load can be restrained low. In the case of  
downsizing the vehicle, an entire length of the column

is reduced, wherein it is difficult to ensure a sufficient collapsible stroke. According to the fifth embodiment, when the secondary collision happens, the outer column 21 can be easily slide on the inner column 11 in the telescoping direction. Therefore, even when the column itself is shortened, a merit is that the collapsible stroke can be substantially increased.

FIG. 14 is a sectional view, similar to FIG. 1, of a tilt type steering apparatus according to a sixth embodiment of the present invention. The sixth embodiment is different from the first embodiment shown in FIG. 1 chiefly about a configuration of the tension member, etc., and therefore the common components are marked with the same numerals and symbols, of which the repetitive explanations are herein omitted.

Referring to FIG. 14, a tension member 113 is constructed of a lower side portion 113a taking a U-shape in section and an upper side portion 113b fastened by bolts 114 that cover open areas thereof. Male screw portions 116c, 117c of fixing members 116, 117 are screwed into screw holes 113e, 113f formed in the lower side portion 113a, whereby the tension member 113 is secured to between the pair of brackets 12. According to the sixth embodiment, the respective bolts 114 can be fastened in the same direction (from above), and hence assembling characteristics are more advantageous than in the embodiments discussed above.



An interior space, which is configured by the lower side portion 113a and the upper side portion 113b of the tension member 113, takes substantially an octagonal shape and accommodates an outer column 121 assuming substantially a C-shape in section, corresponding thereto. The outer column 121 is made of an aluminum material (or a magnesium material) by die casting and can therefore be, as illustrated in FIG. 14, in an arbitrary configuration having an open area at its lower portion and having a large wall thickness on the lower side.

A cylindrical inner column 111 taking substantially an octagonal shape in section is disposed inwardly of the outer column 121. In an assembled state, the inner column 111 and the outer column 121, which are non-cylindrical in their sectional shapes, engage with each other, so that the inner column 111 can be restrained from rotating about the axis. Note that the section of the inner column 111 is not limited to the octagonal shape and may take polygonal shapes other the octagon.

FIG. 15 is a sectional view, similar to FIG. 14, of the tilt type steering apparatus according to a seventh embodiment of the present invention. The seventh embodiment is different from the sixth embodiment shown in FIG. 14 mainly about a configuration of the tension member, etc., and

therefore the common components are marked with the same numerals and symbols, of which the repetitive explanations are herein omitted.

In the seventh embodiment, a tension member 213  
5 is constructed of a main body 213a, of which a lower portion is open, taking an inverted U-shape in section, and a tube 213b bridged between lower side ends of both-sided walls of the main body 213a, and fixed to the main body 213a by a bolt 214 inserted through  
10 within this tube 213b. The male screw portions 116c, 117c of the fixing members 116, 117 are screwed into screw holes 213e, 213f formed in the main body 213a, whereby the tension member 213 is secured to between the pair of brackets 12. There may suffice a less  
15 number of parts than in the sixth embodiment shown in FIG. 14, and the bolt 214 may involve the use of a standard bolt. Further, the tube 213b can be manufactured simply by cutting an annular tube to a predetermined length, thereby attaining a lower-cost  
20 scheme. Note that tube 213b may be manufactured by rounding a plate material.

An annular-tube-like outer column 221 with its lowermost portion notched in the axis-direction, is disposed in an interior of the tension member 213. The  
25 outer column 221, of which an uppermost portion is small in its wall thickness and of which the lowermost portion is notched, is therefore capable of easily

deforming in a diameter reducing direction. The annular-tube-like inner column 111 is disposed within the outer column 221.

FIG. 16 is a sectional view, similar to FIG. 15,  
5 of the tilt type steering apparatus according to an eighth embodiment of the present invention. The eighth embodiment is different from the seventh embodiment shown in FIG. 15 mainly about a configuration of the tension member, etc., and therefore the common  
10 components are marked with the same numerals and symbols, of which the repetitive explanations are herein omitted.

In the eighth embodiment, a tension member 313 is constructed of a main body 313a, of which a lower  
15 portion is open, taking an inverted U-shape in section, and a bolt 314 for connecting both-sided walls of the main body 313a. The bolt 314 includes a screw portion 314a screwed into one side wall (on the left side in FIG. 16), and a thick rod portion 314b having a stepped  
20 portion contiguous to the screw portion 314a. According to the eighth embodiment, the bolt 314 itself structures part of the tension member 313. As the stepped portion of the thick rod portion 314b abuts on the side wall of the main body 313a, an interval  
25 between the walls on both sides becomes fixed by fastening the bolt 314. Because of having no necessity of using the tube as needed for the seventh embodiment

in FIG. 15, a larger number of parts can be reduced.  
In the eighth embodiment discussed above, the tension  
member may be formed of a sintered material, a drawn  
material, a cold forged material, a deformed wire  
5 material, a thick plate material, and so on.

The present invention has been explained in depth  
so far by way of the embodiments. The present  
invention should not, however, be construed as limited  
to the embodiments discussed above and can be, as a  
10 matter of course, modified and improved properly within  
the range that does not spoil the gist of the invention.  
For example, if teeth meshing with each other at every  
predetermined angle are formed on face-to-face surfaces  
of the brackets 12 and of the flange portions 21c, 21d,  
15 when fastening the lever L, the retaining force can be  
further increased.